

WHAT IS CLAIMED IS:

- 1 1. Apparatus for removing particles from a surface of an article to be cleaned,
2 said apparatus comprising:
3 a pump; and
4 a first tube or slot connected at one end to said pump so as to create a flow
5 of a first gas in said first tube or slot, and having the other end substantially facing
6 said surface;
7 wherein a juxtaposition of said first end and said surface, together with
8 said flow of said first gas in said first tube or slot, forms a shock wave sufficient to
9 dislodge said particles from said surface of said article.
- 1 2. An apparatus as claimed in claim 1, wherein said flow of said first gas in
2 said first tube or slot results from a pressure differential between an inside of said
3 first tube or slot, and an outside of said first tube or slot.
- 1 3. An apparatus as claimed in claim 2, wherein said pressure differential is
2 such that a pressure in said first tube or slot is less than a pressure outside of said
3 first tube or slot.
- 1 4. An apparatus as claimed in claim 3, wherein said pump is a vacuum pump.
- 1 5. An apparatus as claimed in claim 2, wherein said pressure differential is
2 such that a pressure in said first tube or slot is greater than a pressure outside of
3 said first tube or slot.
- 1 6. An apparatus as claimed in claim 5, wherein said pump pumps gas into
2 said first tube or slot.
- 1 7. An apparatus as claimed in claim 1, further comprising means for effecting
2 relative movement between said first tube or slot and said surface.
- 1 8. An apparatus as claimed in claim 7, wherein said means for effecting
2 relative movement comprises means for moving said first tube or slot across said
3 surface in raster fashion.
- 1 9. An apparatus as claimed in claim 7, wherein said means for effecting
2 relative movement comprises means for rotating said article, and means for

3 passing said first tube or slot between a center of said article and a perimeter of
4 said article.

1 10. An apparatus as claimed in claim 7, wherein said means for effecting
2 relative movement causes relative movement between one or more particular areas
3 of said surface, and said first tube or slot.

1 11. An apparatus as claimed in claim 10, whereby one or more particular areas
2 of said surface are cleaned to a greater extent than other areas of said surface.

1 12. An apparatus as claimed in claim 1, wherein a tip of said other end of said
2 first tube or slot has one of a half-conical shape, a truncated half-conical shape, a
3 conical shape, or a rounded shape.

1 13. An apparatus as claimed in claim 1, wherein said other end of said first
2 tube or slot is disposed so as to form a predetermined gap between said surface
3 and said first tube or slot, said shock wave being formed in said gap.

1 14. An apparatus as claimed in claim 1, further comprising a further tube or
2 slot, concentric with and inside said first tube or slot, for providing a flow of a
3 second gas toward said surface of said article, said shock wave being formed by
4 flow of said second gas in said first tube or slot.

1 15. An apparatus as claimed in claim 14, wherein said second gas is the same
2 as said first gas.

1 16. An apparatus as claimed in claim 14, wherein a vacuum is formed in said
2 further tube or slot.

1 17. An apparatus as claimed in claim 1, further comprising a plurality of said
2 tubes or slots, each having a respective end substantially facing said surface, and
3 each of said tubes or slots having a pressure within that is sufficiently different
4 from a pressure without to form a shock wave at said respective end.

1 18. An apparatus as claimed in claim 1, further comprising a further tube or
2 slot juxtaposed with respect to an opposite surface of said article from said first
3 tube or slot so as to effect cleaning of said surface and said opposite surface.

1 19. An apparatus as claimed in claim 1, wherein said article is a
2 semiconductor wafer.

1 20. An apparatus as claimed in claim 1, wherein said article is a reticle.

1 21. A method of removing particles from a surface of an article to be cleaned,
2 said method comprising providing a first tube or slot with one end connected to a
3 pump and the other end disposed substantially facing said surface, and providing a
4 flow of a first gas in said first tube or slot so as to induce a pressure differential
5 between an inside of said first tube or slot, and an outside of said first tube or slot,
6 said pressure differential forming a shock wave sufficient to dislodge said
7 particles from said surface.

1 22. A method as claimed in claim 21, wherein providing said flow of said first
2 gas comprises reducing a pressure in said first tube or slot with respect to a
3 pressure outside of said first tube or slot.

1 23. A method as claimed in claim 21, wherein providing said flow of said first
2 gas comprises increasing a pressure in said first tube or slot with respect to a
3 pressure outside of said first tube or slot.

1 24. A method as claimed in claim 21, further comprising effecting relative
2 movement between said first tube or slot and said surface.

1 25. A method as claimed in claim 24, wherein said effecting relative
2 movement comprises moving said first tube or slot across said surface in raster
3 fashion.

1 26. A method as claimed in claim 24, wherein said effecting relative
2 movement comprises rotating said article, and passing said first tube or slot
3 between a center of said article and an external perimeter of said article.

1 27. A method as claimed in claim 24, wherein said effecting relative
2 movement causes relative movement between one or more particular areas of said
3 surface, and said tube or slot.

1 28. A method as claimed in claim 27, whereby one or more particular areas of
2 said surface are cleaned to a greater extent than other areas of said surface.

1 29. A method as claimed in claim 21, wherein said providing said first tube or
2 slot comprises disposing said other end so as to form a predetermined gap

3 between said surface and said first tube or slot, said shock wave being formed in
4 said gap.

1 30. A method as claimed in claim 21, further comprising providing a further
2 tube or slot, concentric with and inside said first tube or slot, for providing a flow
3 of a second gas within said further tube or slot, said shock wave being formed by
4 flow of said second gas in said first tube or slot.

1 31. A method as claimed in claim 30, wherein said second gas is the same as
2 said first gas.

1 32. A method as claimed in claim 30, further comprising forming a vacuum in
2 said further tube or slot.

1 33. A method as claimed in claim 21, further comprising providing a plurality
2 of said tubes or slots, each of said tubes or slots having a respective end
3 substantially facing said surface, each of said tubes or slots having a pressure
4 within that is sufficiently different from a pressure without to form a shock wave
5 at said respective end.

1 34. A method as claimed in claim 21, further comprising providing a further
2 tube or slot juxtaposed with respect to an opposite surface of said article from said
3 first tube or slot so as to effect cleaning of said surface and said opposite surface.

1 35. A method as claimed in claim 21, wherein said article is a semiconductor
2 wafer.

1 36. A method as claimed in claim 21, wherein said article is a reticle.